

CLAIM AMENDMENTS

1 1. (Currently Amended) A method for processing data received from a communications  
2 channel comprising the computer-implemented steps of:  
3 at a receiver, receiving, from the communications channel, received data that is based  
4 upon both modulated data and noise that includes noise from a source that is  
5 external to the receiver, wherein the modulated data is the result of original  
6 data modulated onto one or more carriers;  
7 at the receiver, equalizing the received data to generate equalized data, wherein the  
8 equalizing is performed using an algorithm with a set of one or more  
9 coefficients selected based on noise power and an impulse response of the  
10 communications channel; and  
11 at the receiver, recovering an estimate of the original data by demodulating the  
12 equalized data.

1 2. (Original) The method as recited in Claim 1, wherein the set of one or more  
2 coefficients is selected to optimize an impulse response length of the communications  
3 channel to reduce interference.

1 3. (Original) The method as recited in Claim 2, wherein the interference includes inter-  
2 symbol interference.

1 4. (Original) The method as recited in Claim 2, wherein the interference includes inter-  
2 channel interference.

1 5. (Original) The method as recited in Claim 1, wherein the set of one or more  
2 coefficients is selected to reduce the noise power.

1 6. (Currently Amended) The method as recited in Claim 5, wherein the set of one or  
2 more coefficients is selected to minimize the noise power.

- 1 7. (Original) The method as recited in Claim 1, wherein the set of one or more  
2 coefficients is selected to simultaneously optimize an impulse response length of the  
3 communications channel to reduce interference and reduce the noise power.
- 1 8. (Original) The method as recited in Claim 1, wherein a cyclic prefix is added to the  
2 modulated data and the set of one or more coefficients is selected to ensure that an  
3 impulse response of the communications channel and a device that performs the step  
4 of equalizing is less than a length of the cyclic prefix.
- 1 9. (Original) The method as recited in Claim 1, wherein the set of one or more  
2 coefficients is selected to reduce the noise power due to inter-symbol interference,  
3 inter-channel interference, and noise from one or more additional interference  
4 sources.
- 1 10. (Currently Amended) The method as recited in Claim 9, wherein the one or more  
2 additional interference sources are external to the receiver and includes at least one  
3 interference source selected from the group consisting of crosstalk,  
4 amplitude-modulated signals, and white Gaussian noise.
- 1 11. (Original) The method as recited in Claim 1, wherein the set of one or more  
2 coefficients are selected by minimizing a function of communications channel  
3 impulse response and noise power.
- 1 12. (Original) The method as recited in Claim 1, wherein the set of one or more  
2 coefficients are selected based on a noise power spectral density.
- 1 13. (Original) The method as recited in Claim 1, wherein the step of equalizing the  
2 received data includes processing the received data using a finite impulse response  
3 (FIR) filter.

- 1 14. (Currently Amended) The method as recited in Claim 13, wherein the received data  
2 is modulated using discrete multitone modulation and a set of one or more (FIR)  
3 coefficients for the FIR filter is selected to minimize the noise power and optimize  
4 impulse response length of the communications channel to reduce interference.
- 1 15. (Original) The method as recited in Claim 1, wherein the communications channel is  
2 a twisted pair telephone line.
- 1 16. (Currently Amended) The method as recited in Claim [[1]] 15, wherein the twisted  
2 pair telephone line uses a transmission protocol selected from the group consisting of  
3 Asymmetric Digital Subscriber Line (ADSL), G.Lite and Very High Bit Rate DSL  
4 (VDSL).
- 1 17. (Original) A method for determining coefficients for use in a filter to process data  
2 received from a communications channel comprising the computer-implemented steps  
3 of:  
4 determining a communications channel transfer function based on the received data;  
5 determining a noise power spectral density based on the received data;  
6 determining a communications channel impulse response based on the  
7 communications channel transfer function;  
8 determining a noise covariance based on the noise power spectral density; and  
9 determining the coefficients based on the communications channel impulse response  
10 and the noise covariance.
- 1 18. (Original) The method as recited in Claim 17, wherein the step of determining the  
2 communications channel transfer function includes the computer-implemented steps  
3 of:  
4 accumulating a plurality of symbol values based on the received data;  
5 determining an average received symbol value based on the received data; and

6 determining the communications channel transfer function based on the plurality of  
7 symbol values and the average received symbol value.

1 19. (Original) The method as recited in Claim 17, wherein the step of determining the  
2 noise power spectral density includes the computer-implemented steps of:  
3 measuring a plurality of symbol values based on the received data;  
4 determining an average received symbol value based on the received data; and  
5 determining the noise power spectral density based on the plurality of symbol values  
6 and the average received symbol value.

1 20. (Original) The method as recited in Claim 17, wherein the step of determining the  
2 communications channel impulse response includes the computer-implemented step  
3 of:  
4 determining the communications channel impulse response based on an inverse fast  
5 Fourier transform (FFT) of the communications channel transfer function.

1 21. (Original) The method as recited in Claim 17, wherein the step of determining the  
2 noise covariance includes the computer-implemented step of:  
3 determining the noise covariance based on an inverse fast Fourier transform (FFT) of  
4 the noise power spectral density.

1 22. (Original) The method as recited in Claim 17, wherein the step of determining the  
2 coefficients includes the computer-implemented steps of:  
3 forming two matrices based on the communications channel impulse response and the  
4 noise covariance;  
5 generating a quadratic expression based on the two matrices; and  
6 minimizing the quadratic expression to determine the coefficients.

1 23. (Currently Amended) A computer-readable medium carrying one or more sequences  
2 of instructions for processing data received from a communications channel, wherein  
3 execution of the one or more sequences of instructions by one or more processors  
4 causes the one or more processors to perform the steps of:  
5 at a receiver, receiving, from the communications channel, received data that is based  
6 upon both modulated data and noise that includes noise from a source that is  
7 external to the receiver, wherein the modulated data is the result of original  
8 data modulated onto one or more carriers;  
9 at the receiver, equalizing the received data to generate equalized data, wherein the  
10 equalizing is performed using an algorithm with a set of one or more  
11 coefficients selected based on noise power and an impulse response of the  
12 communications channel; and  
13 at the receiver, recovering an estimate of the original data by demodulating the  
14 equalized data.

1 24. (Original) The computer-readable medium as recited in Claim 23, wherein the set of  
2 one or more coefficients is selected to optimize an impulse response length of the  
3 communications channel to reduce interference.

1 25. (Original) The computer-readable medium as recited in Claim 24, wherein the  
2 interference includes inter-symbol interference.

1 26. (Original) The computer-readable medium as recited in Claim 24, wherein the  
2 interference includes inter-channel interference.

1 27. (Original) The computer-readable medium as recited in Claim 23, wherein the set of  
2 one or more coefficients is selected to reduce the noise power.

1 28. (Currently Amended) The computer-readable medium as recited in Claim 27,  
2 wherein the set of one or more coefficients is selected to minimize the noise power.

- 1 29. (Original) The computer-readable medium as recited in Claim 23, wherein the set of  
2 one or more coefficients is selected to simultaneously optimize an impulse response  
3 length of the communications channel to reduce interference and reduce the noise  
4 power.
- 1 30. (Original) The computer-readable medium as recited in Claim 23, wherein a cyclic  
2 prefix is added to the modulated data and the set of one or more coefficients is  
3 selected to ensure that an impulse response of the communications channel and a  
4 device that performs the step of equalizing is less than a length of the cyclic prefix.
- 1 31. (Original) The computer-readable medium as recited in Claim 23, wherein the set of  
2 one or more coefficients is selected to reduce the noise power due to inter-symbol  
3 interference, inter-channel interference, and noise from one or more additional  
4 interference sources.
- 1 32. (Currently Amended) The computer-readable medium as recited in Claim 31,  
2 wherein the one or more additional interference sources are external to the receiver  
3 and includes at least one interference source selected from the group consisting of  
4 crosstalk, amplitude-modulated signals, and white Gaussian noise.
- 1 33. (Original) The computer-readable medium as recited in Claim 23, wherein the set of  
2 one or more coefficients are selected by minimizing a function of communications  
3 channel impulse response and noise power.
- 1 34. (Original) The computer-readable medium as recited in Claim 23, wherein the set of  
2 one or more coefficients are selected based on a noise power spectral density.

1 35. (Original) The computer-readable medium as recited in Claim 23, wherein the  
2 instructions for equalizing the received data further comprise instructions which,  
3 when executed by the one or more processors, cause the one or more processors to  
4 carry out the step of processing the received data using a finite impulse response  
5 (FIR) filter.

1 36. (Currently Amended) The computer-readable medium as recited in Claim 35,  
2 wherein the received data is modulated using discrete multitone modulation and a set  
3 of one or more (FIR) coefficients for the FIR filter is selected to minimize the noise  
4 power and optimize impulse response length of the communications channel to  
5 reduce interference.

1 37. (Original) The computer-readable medium as recited in Claim 23, wherein the  
2 communications channel is a twisted pair telephone line.

1 38. (Currently Amended) The computer-readable medium as recited in Claim ~~23~~ 37,  
2 wherein the twisted pair telephone line uses a transmission protocol selected from the  
3 group consisting of Asymmetric Digital Subscriber Line (ADSL), G.Lite and Very  
4 High Bit Rate DSL (VDSL).

1 39. (Original) A computer-readable medium carrying one or more sequences of  
2 instructions for determining coefficients for use in a filter to process data received  
3 from a communications channel, wherein execution of the one or more sequences of  
4 instructions by one or more processors causes the one or more processors to perform  
5 the steps of:  
6 determining a communications channel transfer function based on the received data;  
7 determining a noise power spectral density based on the received data;  
8 determining a communications channel impulse response based on the  
9 communications channel transfer function;  
10 determining a noise covariance based on the noise power spectral density; and

11           determining the coefficients based on the communications channel impulse response  
12           and the noise covariance.

1    40.   (Original) The computer-readable medium as recited in Claim 39, wherein the  
2           instructions for determining the communications channel transfer function further  
3           comprise instructions which, when executed by the one or more processors, cause the  
4           one or more processors to carry out the steps of:  
5           accumulating a plurality of symbol values based on the received data;  
6           determining an average received symbol value based on the received data; and  
7           determining the communications channel transfer function based on the plurality of  
8           symbol values and the average received symbol value.

1    41.   (Original) The computer-readable medium as recited in Claim 39, wherein the  
2           instructions for determining the noise power spectral density further comprise  
3           instructions which, when executed by the one or more processors, cause the one or  
4           more processors to carry out the steps of:  
5           measuring a plurality of symbol values based on the received data;  
6           determining an average received symbol value based on the received data; and  
7           determining the noise power spectral density based on the plurality of symbol values  
8           and the average received symbol value.

1    42.   (Original) The computer-readable medium as recited in Claim 39, wherein the  
2           instructions for determining the communications channel impulse response further  
3           comprise instructions which, when executed by the one or more processors, cause the  
4           one or more processors to carry out the step of:  
5           determining the communications channel impulse response based on an inverse fast  
6           Fourier transform (FFT) of the communications channel transfer function.



1 43. (Original) The computer-readable medium as recited in Claim 39, wherein the  
2 instructions for determining the noise covariance further comprise instructions which,  
3 when executed by the one or more processors, cause the one or more processors to  
4 carry out the step of:  
5 determining the noise covariance based on an inverse fast Fourier transform (FFT) of  
6 the noise power spectral density.

1 44. (Original) The computer-readable medium as recited in Claim 39, wherein the  
2 instructions for determining the coefficients further comprise instructions which,  
3 when executed by the one or more processors, cause the one or more processors to  
4 carry out the steps of:  
5 forming two matrices based on the communications channel impulse response and the  
6 noise covariance;  
7 generating a quadratic expression based on the two matrices; and  
8 minimizing the quadratic expression to determine the coefficients.

1 45. (Currently Amended) ~~An apparatus~~ A receiver for processing data received from a  
2 communications channel comprising:  
3 an equalizer configured to equalize received data from the communications channel  
4 and generate equalized data, wherein the received data is based upon both  
5 modulated data and noise that includes noise from a source that is external to  
6 the receiver, and the modulated data is the result of original data modulated  
7 onto one or more carriers, and wherein the equalizer is configured to use an  
8 algorithm with a set of one or more coefficients selected based on noise power  
9 and an impulse response of the communications channel; and  
10 a demodulator configured to generate an estimate of the original data by demodulating  
11 the equalized data.

- 1 46. (Original) The apparatus as recited in Claim 45, wherein the set of one or more  
2 coefficients is selected to optimize an impulse response length of the communications  
3 channel to reduce interference.
- 1 47. (Original) The apparatus as recited in Claim 46, wherein the interference includes  
2 inter-symbol interference.
- 1 48. (Original) The apparatus as recited in Claim 46, wherein the interference includes  
2 inter-channel interference.
- 1 49. (Original) The apparatus as recited in Claim 45, wherein the set of one or more  
2 coefficients is selected to reduce the noise power.
- 1 50. (Currently Amended) The apparatus as recited in Claim 49, wherein the set of one or  
2 more coefficients is selected to minimize the noise power.
- 1 51. (Original) The apparatus as recited in Claim 45, wherein the set of one or more  
2 coefficients is selected to simultaneously optimize an impulse response length of the  
3 communications channel to reduce interference and reduce the noise power.
- 1 52. (Original) The apparatus as recited in Claim 45, wherein a cyclic prefix is added to  
2 the modulated data and the set of one or more coefficients is selected to ensure that an  
3 impulse response of the communications channel and the equalizer is less than a  
4 length of the cyclic prefix.
- 1 53. (Original) The apparatus as recited in Claim 45, wherein the set of one or more  
2 coefficients is selected to reduce the noise power due to inter-symbol interference,  
3 inter-channel interference, and noise from one or more additional interference  
4 sources.

- 1 54. (Currently Amended) The apparatus as recited in Claim 53, wherein the one or more  
2 additional interference sources are external to the receiver and includes at least one  
3 interference source selected from the group consisting of crosstalk,  
4 amplitude-modulated signals, and white Gaussian noise.
- 1 55. (Original) The apparatus as recited in Claim 45, wherein the set of one or more  
2 coefficients are selected by minimizing a function of communications channel  
3 impulse response and noise power.
- 1 56. (Original) The apparatus as recited in Claim 45, wherein the set of one or more  
2 coefficients are selected based on a noise power spectral density.
- 1 57. (Original) The apparatus as recited in Claim 45, wherein the equalizer is configured  
2 to process the received data using a finite impulse response (FIR) filter.
- 1 58. (Currently Amended) The apparatus as recited in Claim 57, wherein the received data  
2 is modulated using discrete multitone modulation and a set of one or more (FIR)  
3 coefficients for the FIR filter is selected to the minimize noise power and optimize  
4 impulse response length of the communications channel to reduce interference.
- 1 59. (Original) The apparatus as recited in Claim 45, wherein the communications  
2 channel is a twisted pair telephone line.
- 1 60. (Currently Amended) The apparatus as recited in Claim ~~45~~ 59, wherein the twisted  
2 pair telephone line uses a transmission protocol selected from the group consisting of  
3 Asymmetric Digital Subscriber Line (ADSL), G.Lite and Very High Bit Rate DSL  
4 (VDSL).

1 61. (Original) An apparatus for determining coefficients for use in a filter to process data  
2 received from a communications channel comprising:  
3 means for determining a communications channel transfer function based on the  
4 received data;  
5 means for determining a noise power spectral density based on the received data;  
6 means for determining a communications channel impulse response based on the  
7 communications channel transfer function;  
8 means for determining a noise covariance based on the noise power spectral density;  
9 and  
10 means for determining the coefficients based on the communications channel impulse  
11 response and the noise covariance.

1 62. (Original) The apparatus as recited in Claim 61, wherein the means for determining  
2 the communications channel transfer function includes:  
3 means for accumulating a plurality of symbol values based on the received data;  
4 means for determining an average received symbol value based on the received data;  
5 and  
6 means for determining the communications channel transfer function based on the  
7 plurality of symbol values and the average received symbol value.

1 63. (Original) The apparatus as recited in Claim 61, wherein the means for determining  
2 the noise power spectral density includes:  
3 means for measuring a plurality of symbol values based on the received data;  
4 means for determining an average received symbol value based on the received data;  
5 and  
6 means for determining the noise power spectral density based on the plurality of  
7 symbol values and the average received symbol value.

- 1 64. (Original) The apparatus as recited in Claim 61, wherein the means for determining  
2 the communications channel impulse response includes:  
3 means for determining the communications channel impulse response based on an  
4 inverse fast Fourier transform (FFT) of the communications channel transfer  
5 function.
- 1 65. (Original) The apparatus as recited in Claim 61, wherein the means for determining  
2 the noise covariance includes:  
3 means for determining the noise covariance based on an inverse fast Fourier  
4 transform (FFT) of the noise power spectral density.
- 1 66. (Original) The apparatus as recited in Claim 61, wherein the means for determining  
2 the coefficients includes:  
3 means for forming two matrices based on the communications channel impulse  
4 response and the noise covariance;  
5 means for generating a quadratic expression based on the two matrices; and  
6 means for minimizing the quadratic expression to determine the coefficients.
- 1 67. (Currently Amended) A method for generating coefficient data comprising the  
2 computer-implemented step of:  
3 at a receiver, generating coefficient data that represents a set of one or more  
4 coefficients that are selected based on noise power and an impulse response of  
5 a communications channel when the coefficients are used with an algorithm to  
6 equalize received data from the communications channel, wherein the  
7 received data is based upon both modulated data and noise that includes noise  
8 from a source that is external to the receiver and the modulated data is the  
9 result of original data modulated onto one or more carriers.

1 68. (Currently Amended) A computer-readable medium carrying coefficient data to be  
2 used by a receiver and that represents a set of one or more coefficients that are  
3 selected based on noise power and an impulse response of a communications channel  
4 when the coefficients are used with an algorithm to equalize received data from the  
5 communications channel, wherein the received data is based upon both modulated  
6 data and noise that includes noise from a source that is external to the receiver and the  
7 modulated data is the result of original data modulated onto one or more carriers.

1 69. (Currently Amended) An apparatus for generating coefficient data comprising:  
2 a storage medium for storing the coefficient data; and  
3 a coefficient generator that is within a receiver and that is configured to generate the  
4 coefficient data, wherein the coefficient data represents a set of one or more  
5 coefficients that are selected based on noise power and an impulse response of  
6 a communications channel when the coefficients are used with an algorithm to  
7 equalize received data from the communications channel, wherein the received  
8 data is based upon both modulated data and noise that includes noise from a  
9 source that is external to the receiver and the modulated data is the result of  
10 original data modulated onto one or more carriers.